

# Daily activity, moult and morphometrics of the birds of São Tomé and Príncipe

Tony King<sup>a</sup> and Martin Dallimer<sup>b</sup>

De décembre 2001 à février 2002, des inventaires à l'aide de filets japonais ont été effectués dans chacun des trois principaux types de forêt primaire de Sao Tomé, avec une attention particulière pour la forêt primaire de basse altitude. Cet habitat a également été inventorié à Príncipe, ainsi qu'un petit nombre d'autres sites à Sao Tomé et à Príncipe. Au total, 149 oiseaux de 18 espèces ont été capturés pendant l'étude, dont 147 (de 16 espèces) à Sao Tomé et deux (de deux espèces) à Príncipe. La proportion d'oiseaux muant leurs rémiges a augmenté régulièrement au fil de l'étude: à la mi-décembre aucun oiseau n'était en mue, tandis qu'à la mi-février 60% l'étaient. La longueur alaire et le poids sont présentés pour l'ensemble des oiseaux capturés. L'importance de la forêt primaire de basse altitude de Sao Tomé pour les espèces endémiques menacées est mise en évidence; en effet, deux espèces classées comme menacées d'extinction par BirdLife International<sup>1</sup>, la Nasique de Bocage *Amaurocichla bocagei* et la Pie-grièche de Sao Tomé *Lanius newtoni*, n'ont été capturées que dans cet habitat. Il faut espérer que le regain d'intérêt au niveau international pour la biodiversité de ces îles pourra aboutir à la conservation efficace de ces forêts exceptionnelles et de l'unique biodiversité qu'elles supportent.

The islands of São Tomé and Príncipe, off the west coast of Africa in the Gulf of Guinea, have long been known to support a rich endemic flora and fauna<sup>8</sup>. Such high levels of endemism within tiny geographical areas (Peet & Atkinson<sup>10</sup> give São Tomé as 857 km<sup>2</sup> and Príncipe as 139 km<sup>2</sup>) lead to many conservation concerns. On São Tomé alone, the IUCN<sup>7</sup> lists 11 species of breeding landbird as under some degree of conservation threat, all of which are endemic. Despite these concerns, biodiversity research on the islands has been limited, and the biology of many species is still relatively unknown, even among the avifauna<sup>4,9,10</sup>. The present study aimed to utilise mist-net techniques to provide quantitative data regarding habitat use, daily activity, moult and biometrics of the birds of São Tomé and Príncipe, particularly those endemics found in remaining areas of primary forest.

## Methods

Between December 2001 and February 2002, mist-net surveys were conducted within each of the three major primary forest types on São Tomé, described as mossy (>1,400 m altitude), montane (800–1,400 m) and lowland (0–800 m)<sup>9,10</sup>. Particular emphasis was placed on lowland primary forest, as this is the only habitat type known to support all of São Tomé's endemic species<sup>10</sup>. Lowland primary forest on Príncipe was also

surveyed, as were a small number of other sites in both São Tomé and Príncipe (see Table 1).

Fifteen square metres of mist-nets (generally 6 m x 2.5 m, but also 10 m x 1.5 m) with 38-mm mesh were used during the study. Most were set at understorey level (0.5–4.0 m above ground), with a few at midstorey level (3–9 m). No canopy nets were used. Whenever possible, nets were opened at 05.00 hrs (just prior to dawn) and kept open until after 18.00 hrs (dusk), though timing was frequently constrained by logistical factors. Therefore net-effort was quantified in terms of net-hours, rather than net-days, and general capture rates are presented as birds per net-hour. For individual species, capture rates per 100 net-hours are presented.

Captured birds were identified (and occasionally sexed according to plumage characters) using Christy & Clarke<sup>4</sup>. Individuals with large and/or bright gapes were recorded as probable juveniles. Mass was measured using spring balances, to the nearest g for birds weighing less than 65 g or to the nearest 5 g for heavier birds. Wing length was measured to the nearest mm, using a wing-rule and flattening the primaries gently against the rule (i.e. following Svensson<sup>11</sup>). Other measurements were taken using a pair of dial callipers, but are not presented here. Each bird was assessed for moult of flight (ie primaries, secondaries and tertials) and tail feathers, again

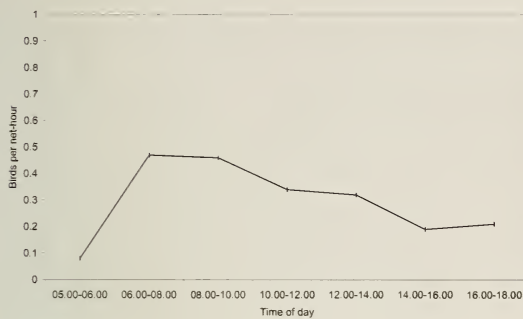


Figure 1. Daily activity patterns, indicated by capture rates per net-hour, of birds in primary forest sites in São Tomé.

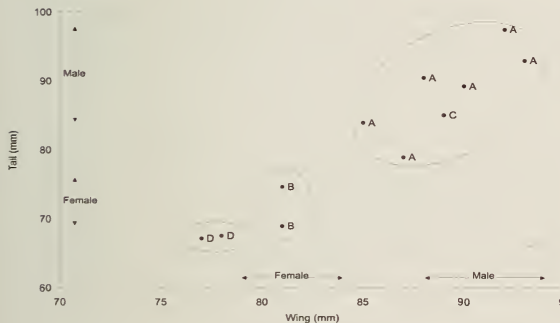
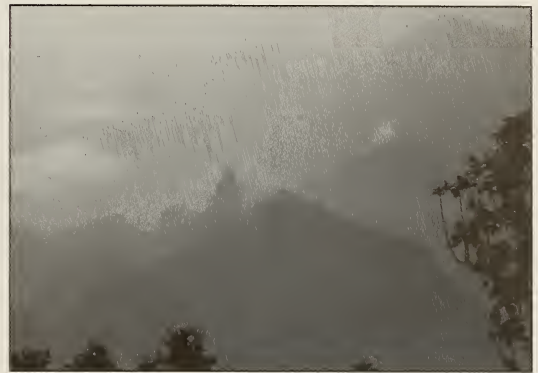


Figure 2. Determination of sex ratios within groups of Giant Sunbird *Dreptes thomensis* based on morphometrics. Data points labelled with the same letter indicate individuals captured in the same mist-net at the same time. Tail length was measured to cloaca. Wing and tail ranges for males and females are taken from Cheke & Mann<sup>3</sup>. Therefore, groups A and C are likely to consist of all males, group B of females, and group D of juveniles (the latter supported by observation of gape colour). Note that groups C and D were captured within 5 m and 15 minutes of each other.

following Svensson<sup>11</sup>. Nomenclature generally follows Borrow & Demey<sup>2</sup>.

## Results

One hundred and forty-nine birds of 18 species were captured during the study, 147 (16 species) on São Tomé and two (two species) on Príncipe (Table 1). Overall capture rates varied between sites, particularly between the two islands, with high capture rates on São Tomé, and very low rates on Príncipe (Table 1). Although some species exhibited variation in capture rates between habitat types, there were no clear trends in overall capture rates between the habitat types; indeed, much inter-habitat variation in overall capture rates on São Tomé could be attributed to variation in the



3



4



5

Figure 3. View from Mesa de Pico, December 2001; the imposing rugged terrain limits access to much of São Tomé's primary forest (Tony King)

Figure 4. Typical high-altitude mossy forest at Estação Sousa, December 2001 (Martin Dallimer)

Figure 5. Lowland forest along the rio São Miguel, January 2002, home to high densities of endangered endemic species, such as São Tomé Short-tail *Amaurocichla bocagei* (Martin Dallimer)

**Table 1.** Summary data for mist-net sites in São Tomé and Príncipe, December 2001–February 2002.

Forest type	Coordinates	Site	No. of nets	Total net hours	No. of species	No. of birds	Birds per net-hour
<b>São Tomé</b>							
Mossy primary	00°16'N 06°33'E	MP	2	16	2	4	0.25
Mossy primary	00°16'N 06°34'E	ES	2	42	7	14	0.34
Montane primary	00°17'N 06°36'E	LA	3	30	5	25	0.83
Lowland primary	00°11'N 06°31'E	Q	4	92	8	20	0.22
Lowland primary	00°10'N 06°30'E	QR1	3	9	3	6	0.67
Lowland primary	00°11'N 06°31'E	QR2	4	97	11	37	0.38
Lowland primary	00°09'N 06°30'E	RSM	5	92	6	14	0.15
Montane cultivated	00°17'N 06°37'E	BS	9	167	9	26	0.16
Coastal cultivated	00°16'N 06°28'E	SC	1	1	1	1	1.00
<b>Total</b>			<b>33</b>	<b>545</b>	<b>16</b>	<b>147</b>	<b>0.27</b>
<b>Príncipe</b>							
Lowland primary	01°34'N 07°22'E	RST	4	35	0	0	0.00
Coastal / secondary	01°34'N 07°22'E	PST	2	8	0	0	0.00
Coastal / secondary	01°36'N 07°20'E	PN	3	19	2	2	0.11
<b>Total</b>			<b>9</b>	<b>62</b>	<b>2</b>	<b>2</b>	<b>0.03</b>

**Table 2.** Capture rates of each species at each site (or grouped site).

Family	Species	Birds per 100 net hours							Total birds captured
		MP/ES	LA	Q	QR1/2	RSM	BS/SC	PN	
Ardeidae	<i>Bubulcus ibis</i>						0.6		1
Columbidae	<i>Columba malherbii</i>				0.9				1
Columbidae	<i>Aplopelia larvata simplex</i>			1.1		2.2			3
Alcedinidae	<i>Alcedo (leucogaster) nais</i>							5.4	1
Alcedinidae	<i>Halcyon malimbica dryas</i>							5.4	1
Turdidae	<i>Turdus o. olivaceofuscus</i>	3.5	3.3	2.2	6.6	3.3			15
Sylviidae	<i>Prinia mollerii</i>	1.7	6.7	1.1	0.9	1.1	1.2		8
Monarchidae	<i>Terpsiphone atrochalybeia</i>	1.7		4.4	5.7	3.3	0.6		15
Timaliidae	<i>Amaurocichla bocagei</i>				1.9	3.3			5
Nectariniidae	<i>Anabathmis newtonii</i>	13.9	13.3	2.2	3.8		2.4		22
Nectariniidae	<i>Dreptes thomensis</i>		-	8.7	2.8				11
Zosteropidae	<i>Speirops lugubris</i>	5.2	56.7		11.3		7.1		44
Laniidae	<i>Lanius newtoni</i>			1.1					1
Ploceidae	<i>Ploceus grandis</i>				0.9				1
Ploceidae	<i>Ploceus sanctithomae</i>	3.5	3.3	1.1	2.8	2.2	0.6		10
Estrildidae	<i>Estrilda astrild</i>						1.2		2
Viduidae	<i>Vidua macroura</i>						0.6		1
Fringillidae	<i>Serinus rufobrunneus thomensis</i>	1.7			2.8		1.8		7
All species		31.3	83.3	21.9	40.7	15.2	16.1	10.8	149
All species except <i>Speirops lugubris</i>		26.1	26.7	21.9	29.3	15.2	8.9	10.8	105

**Table 3.** Time of capture for species with five or more individuals captured in São Tomé (\*for mist-nets in which that species was captured).

Species	Birds per 100 net hours*						
	05.00–06.00	06.00–08.00	08.00–10.00	10.00–12.00	12.00–14.00	14.00–16.00	16.00–18.00
<i>Turdus o. olivaceofuscus</i>	0.0	3.7	8.7	2.8	6.3	6.9	6.3
<i>Prinia mollerii</i>	0.0	2.8	5.9	4.6	8.3	0.0	5.6
<i>Terpsiphone atrochalybeia</i>	0.0	2.8	7.4	8.8	0.3	2.5	4.4
<i>Amaurocichla bocagei</i>	0.0	10.5	6.3	0.0	0.0	7.7	11.5
<i>Anabathmis newtonii</i>	3.3	10.4	3.9	6.1	5.6	0.0	2.7
<i>Dreptes thomensis</i>	0.0	0.0	0.0	0.0	6.2	0.0	19.0
<i>Speirops lugubris</i>	0.0	6.8	8.7	5.5	13.1	2.0	1.2
<i>Ploceus sanctithomae</i>	0.0	9.8	0.5	10.6	1.0	2.5	2.4
<i>Serinus rufobrunneus thomensis</i>	0.0	18.8	0.0	3.4	1.8	0.0	0.0



capture rates of the most frequently trapped species, São Tomé Speirops *Speirops lugubris* (Table 2).

There appeared to be a general pattern of daily activity; considering only primary forest sites in São Tomé, overall capture rates were very low before 06.00 hrs, highest between 06.00 and 10.00 hrs, and then declined during the rest of the day (Fig 1). Again, however, daily activity patterns of some species did not always follow the general trend (Table 3).

---

#### Captions to plates on pages 88 and 89

Figure 6. São Tomé Pigeon *Columba thomensis* in mossy forest near Mesa de Pico, December 2001. An endemic primary forest specialist that was missed by the mist-net survey due to its preference for the canopy (Martin Dallimer)

Figure 7. São Tomé Bronze-naped Pigeon *Columba malherbii*, in the lowland Queijo/Zagaia region, 12 February 2002 (Martin Dallimer)

Figure 8. Lemon Dove *Aplopelia larvata simplex*, at the lowland rio São Miguel site, 6 January 2002 (Martin Dallimer)

Figure 9. São Tomé Prinia *Prinia mollerii*, Bom Sucesso, 15 February 2002 (Martin Dallimer)

Figure 10. Male São Tomé Paradise Flycatcher *Terpsiphone atrochalybeia*, Estação Sousa, 22 December 2001 (Tony King)

Figure 11. Female São Tomé Paradise Flycatcher *Terpsiphone atrochalybeia* in the lowland Queijo/Zagaia region, 8 February 2002 (Martin Dallimer)

Figure 12. São Tomé Short-tail *Amaurocichla bocagei* at the lowland rio São Miguel site, 5 January 2001 (Martin Dallimer)

Figure 13. Male Newton's Sunbird *Anabathmis newtonii* at Bom Sucesso, February 2002 (Martin Dallimer)

Figure 14. Presumed male Giant Sunbird *Dreptes thomensis*, in the lowland Queijo/Zagaia region, 7 February 2002 (Martin Dallimer)

Figure 15. São Tomé Speirops *Speirops lugubris*, Mesa de Pico, 24 December 2001 (Tony King)

Figure 16. São Tomé Fiscal *Lanius newtoni*, in the lowland Queijo/Zagaia region, 8 February 2002 (Martin Dallimer)

Figure 17. Female Giant Weaver *Ploceus grandis*, in primary forest in the lowland Queijo/Zagaia region, 13 February 2002 (Martin Dallimer)

Figure 18. São Tomé Weaver *Ploceus sanctithomae*, Estação Sousa, 23 December 2001 (Tony King)

The survey period coincided with the start of a major moult period among São Tomé birds; the proportion moulting their flight feathers increased steadily during the survey period, from the first sampling in mid-December, when none was in moult, to a peak of 60% in moult by mid-February (Table 4). Although sample sizes for individual species are low, this pattern appeared fairly constant among all trapped species.

Wing and mass measurements are presented for each species captured; male–female comparisons are possible for two species, both of which exhibited sexual dimorphism, particularly in wing length (Table 5).

Species-specific details are presented in the following species accounts. All notes on moult refer only to flight feathers, unless otherwise stated. For all passerines examined, the sequence of moult of the flight feathers appeared to follow the normal sequence exhibited by most European passerines, as described by Svensson<sup>11</sup>, the details of which are beyond the scope of this paper. Non-passerines were more variable, and are described individually.

#### Cattle Egret *Bubulcus ibis*

A single individual of this widespread non-endemic was mist-netted at Bom Sucesso (montane cultivated, BS) on 1 February 2002. There was no sign of moult.

#### São Tomé Bronze-naped Pigeon *Columba malherbii*

Endemic species to São Tomé, Príncipe and Annobón. One was trapped at a lowland ridge-top site in the Queijo/Zagaia region (QR2, São Tomé), on 12 February 2002. The bird was in an unusual state of moult, with all six secondaries on the left wing as pins, as were the first and second primaries and first secondary on the right wing, and all feathers on the left and first (central) on the right of the tail. All other flight and tail feathers were full.

#### Lemon Dove *Aplopelia larvata simplex*

Three individuals of this species, of which the subspecies is endemic to São Tomé, were mist-netted in lowland primary forest, two at the rio São Miguel (RSM), on 6 January 2002, and one in the Queijo/Zagaia region (Q), on 8 February 2002. The latter individual was in moult (left wing: third primary pin and sixth stage 4; right wing, first secondary stage 2; tail also in moult).



6



7



8



9



10



11



12





13



14



15



16



17



18

**Table 4.** Proportion of birds moulting flight feathers during each distinct sampling period in São Tomé; sample sizes are given in parentheses, site codes are presented below dates.

Species	21–25 Dec 01 ES/MP	29–30 Dec 01 LA	5–9 Jan 02 RSM/QR1	1–5 Feb 02 BS/SC	7–13 Feb 02 Q/QR2	15 Feb 02 BS
<i>Bubulcus ibis</i>				0.00 (1)		
<i>Columba malherbii</i>					1.00 (1)	
<i>Aplopelia larvata simplex</i>			0.00 (2)		1.00 (1)	
<i>Turdus o. olivaceofuscus</i>	0.00 (2)	1.00 (1)	0.20 (5)		0.29 (7)	
<i>Prinia mollerii</i>	0.00 (1)	0.00 (2)	0.00 (1)	1.00 (1)	0.00 (2)	0.00 (1)
<i>Terpsiphone atrochalybeia</i>	0.00 (1)		0.00 (3)	0.00 (1)	0.90 (10)	
<i>Amaurocichla bocagei</i>			0.67 (3)		1.00 (2)	
<i>Anabathmis newtonii</i>	0.00 (8)	0.00 (4)		0.67 (3)	0.33 (6)	1.00 (1)
<i>Dreptes thomensis</i>					0.73 (11)	
<i>Speirops lugubris</i>	0.00 (3)	0.06 (17)	0.00 (3)	0.33 (12)	0.22 (9)	
<i>Lanius newtoni</i>					1.00 (1)	
<i>Ploceus grandis</i>					1.00 (1)	
<i>Ploceus sanctithomae</i>	0.00 (2)	0.00 (1)	0.50 (2)	1.00 (1)	1.00 (4)	
<i>Estrilda astrild</i>				1.00 (2)		
<i>Vidua macroura</i>				0.00 (1)		
<i>Serinus rufobrunneus thomensis</i>	0.00 (1)		0.00 (1)	1.00 (3)	0.50 (2)	
Total	0.00 (18)	0.08 (25)	0.20 (20)	0.52 (25)	0.60 (57)	0.50 (2)

**Table 5.** Wing and mass measurements for each species captured in São Tomé and Príncipe, December 2001–February 2002.

Species	Wing (mm)	Mass (g)			range	mean	SD	n	
	range	mean	SD	n					
<i>Bubulcus ibis</i>	250				1	270		1	
<i>Columba malherbii</i>	170				1	165		1	
<i>Aplopelia larvata simplex</i>	148–153	150	2.6		3	160–200	176.7	20.8	3
<i>Alcedo (leucogaster) nais</i>	58				1	19			1
<i>Halcyon malimbica dryas</i> (juvenile)	128				1	70			1
<i>Turdus o. olivaceofuscus</i>	118–136	125.8	5.4		14	75–95	84.2	4.9	13
<i>Prinia mollerii</i>	52–58	53.8	2.4		6	8–11	9.8	1	6
<i>P. mollerii</i> (juvenile)	49				1	9			1
<i>Terpsiphone atrochalybeia</i> (male)	81–92	83.4	3.6		8	14–18	15.6	1.3	8
<i>T. atrochalybeia</i> (female)	75–81	77.4	1.9		7	13–16	13.7	1.3	7
<i>Amaurocichla bocagei</i>	67–70	68.5	1.3		4	19–21	19.6	0.9	5
<i>Anabathmis newtonii</i> (male)	51–58	54.7	1.9		10	7–9	7.8	0.6	12
<i>A. newtonii</i> (female/juvenile)	46–52	49.6	2.2		5	6–8	6.8	1	6
<i>A. newtonii</i> (juvenile)	48				1	6			1
<i>Dreptes thomensis</i>	81–93	87.3	4.3		9	21–28	24.8	2.2	9
<i>D. thomensis</i> (juvenile)	77, 78				2	17, 18			2
<i>Speirops lugubris</i>	69–77	72.1	1.9		30	15–21	17.3	1.5	31
<i>Lanius newtoni</i>	91				1	27			1
<i>Ploceus grandis</i> (female/?juvenile)	110				1	65			1
<i>Ploceus sanctithomae</i>	68–79	73.7	3.8		9	17–24	21.8	2.5	9
<i>Estrilda astrild</i>	46, 48				2	5, 8			2
<i>Vidua macroura</i> (breeding male)	72				1	15			1
<i>Serinus rufobrunneus thomensis</i>	77–84	80.6	2.6		7	21–26	23.3	1.8	7

### Príncipe Kingfisher *Alcedo (leucogaster) nais*

One was captured at Praia da Nova (PN), Príncipe, on 27 January 2002, in a mist-net set among coastal rocks. The taxonomy of this form is disputable, although most recent literature considers it an endemic subspecies of White-bellied Kingfisher *A.*

*leucogaster*. However, when this individual was handled, the long crest feathers were extended outwards, behaviour more characteristic of Malachite Kingfisher *A. cristata* than *A. leucogaster*<sup>6</sup>. The bird was in moult (sixth primary on both wings 4, sixth secondary on left stage 3; tail also in moult).



**Blue-breasted Kingfisher** *Halcyon malimbica dryas*  
A juvenile of this species, of which the subspecies is endemic to Príncipe, was mist-netted at Praia da Nova (PN) on 26 January 2002. No evidence of moult.

**Gulf of Guinea Thrush** *Turdus olivaceofuscus olivaceofuscus*

Species endemic to São Tomé and Príncipe, with endemic subspecies on both islands. It was one of the most frequently captured species on São Tomé. Fifteen were trapped, with similar capture rates in each of the three altitudinal zones of primary forest (Table 2). It was the only species to exhibit a consistently high capture rate throughout the afternoon (Table 3). Four were in moult, the first in late December (Table 4).

**São Tomé Prinia** *Prinia mollerii*

Species endemic to São Tomé. Captured in all three primary forest zones, and also at Bom Sucesso (BS). Though widespread, capture rates were generally low, particularly at lowland sites (Table 2). Of eight birds trapped, only one was in moult (BS, 2 February 2002).

**São Tomé Paradise Flycatcher** *Terpsiphone atrochalybeia*

Species endemic to São Tomé. It exhibited high capture rates at all lowland primary forest sites, also being mist-netted in small numbers in mossy primary and montane cultivated areas (Table 2). Particularly high capture rates were obtained between 08.00 and 12.00 hrs (Table 3), but this result may have been skewed by the simultaneous capture of several individuals. Of five mist-netted between mid-December and early February, none was in moult; however, in mid-February, nine out of ten were moulting (Table 4). One (QR2, 11 February 2002) was moulting from juvenile to adult male plumage. Males and females were captured at similar rates, with males being distinctly larger (Table 5).

**São Tomé Short-tail** *Amaurocichla bocagei*

Species and genus endemic to São Tomé and listed as Vulnerable by IUCN<sup>7</sup> and BirdLife International<sup>1</sup>. Captured exclusively at lowland primary forest sites (Table 2). Though only five individuals were trapped—rio São Miguel, 5 January (one) and 8 January 2002 (two singles);

Queijo/Zagaia region, 12 February 2002 (a pair)—capture rates were notably high during early morning (06.00–08.00 hrs) and late afternoon (16.00–18.00 hrs), with none captured during the period 10.00–14.00 hrs (Table 3). Four of the five were in moult (Table 4).

**Newton's Sunbird** *Anabathmis newtonii*

Species endemic to São Tomé. The second most frequently captured species during the study, though capture rates were much higher at mossy and montane primary forest sites than at lowland primary or cultivated sites (Table 2). It was captured most frequently during early morning (06.00–08.00 hrs), and was only rarely trapped after 14.00 hrs (Table 3). Males were captured more frequently, and were larger, than females (Table 5). None of the 12 caught in December was in moult, while five of the ten captured in February were in moult (Table 4).

**Giant Sunbird** *Dreptes thomensis*

Species and genus endemic to São Tomé and listed as Vulnerable by IUCN<sup>7</sup> and BirdLife International<sup>1</sup>. Captured at two sites, both in lowland primary forest in the Queijo/Zagaia region: site Q, 7 February (six) and 8 February 2002 (two) and site QR2, 11 February 2002 (two and one; Table 2). A total of 11 was mist-netted, all in the afternoon (Table 3), in four groups. Comparing our morphometric data (Table 5 and unpubl.) with those of Cheke & Mann<sup>3</sup>, who demonstrated the species to be sexually dimorphic, it appears that each of these groups was single-sex, with the largest group consisting of six males (Fig 2). Cheke & Mann<sup>3</sup> suggested that the species may be polygamous, based on the observation of twice as many males at sites than females. Eight were in moult.

**São Tomé Speirops** *Speirops lugubris*

Species endemic to São Tomé. The most frequently captured species, but while it was trapped in all altitudinal zones, there was great variation in capture rates between sites (Table 2). At lowland primary forest sites, it was only captured at ridge-top localities in the Queijo/Zagaia region. Two groups, of five and six, were caught in nets at the montane primary site of Lagoa Amelia (LA), contributing to the exceptionally high capture rate at this site (Table 2). There appeared to be a decrease in flight activity in



the afternoon, with most mist-netted between 08.00 and 14.00 hrs, the capture rate declining sharply after 14.00 hrs (Table 3). Seven were in moult, one of 23 mist-netted in December–January, and six of 21 in February (Table 4).

#### **São Tomé Fiscal *Lanius newtoni***

Considered Critically Endangered by IUCN<sup>7</sup> and BirdLife International<sup>1</sup>. A single individual of this rare São Tomé endemic was captured in lowland primary forest in the Queijo/Zagaia region (site Q), on 8 February 2002, immediately following heavy rain. The bird was in moult.

#### **Giant Weaver *Ploceus grandis***

Species endemic to São Tomé that is normally associated with disturbed forest. A female was captured on 13 February 2002 at a ridge-top locale in lowland primary forest in the Queijo/Zagaia region (QR2). The bird was in moult.

#### **São Tomé Weaver *Ploceus sanctithomae***

Species endemic to São Tomé. Captured in all three altitudinal zones, and in both primary forest and cultivated areas, though capture rates were higher at mossy and montane primary forest sites than elsewhere (Table 2). Most captures were between 06.00 and 12.00 hrs, though there was a strangely low capture rate between 08.00 and 10.00 hrs (Table 3). Six were in moult; none of three captured in December, one of two in January, and all five in February (Table 4).

#### **Common Waxbill *Estrilda astrild***

This widespread species was captured on two occasions during the morning of 3 February 2002 at the montane cultivated site, Bom Sucesso (BS). Both were in moult.

#### **Pin-tailed Whydah *Vidua macroura***

A single male in breeding plumage of this non-endemic was mist-netted at Bom Sucesso (BS), on 1 February 2002. No evidence of moult.

**Príncipe Seed-eater *Serinus rufobrunneus thomensis***  
Species endemic to São Tomé, Príncipe and Carço. Seven individuals of the subspecies endemic to São Tomé were captured, in all three altitudinal zones, and at both primary forest and cultivated sites (Table 2). Capture rate was particularly high in early morning, prior to 08.00 hrs (Table 3). While

neither of those captured in December–January was in moult, four of the five mist-netted in February were (Table 4).

## **Discussion**

This study aimed to contribute to our understanding of the biology of several endemic bird species that occur on São Tomé and Príncipe. Many of these species have received very little detailed study in the past, and ours is one of the very few quantitative studies attempted. Capture rates cannot be directly translated into abundance or density estimates, as other external factors influence mist-net success, but these rates do provide quantitative data on variations in habitat use and daily activity patterns. For example, the contrast between the exceptionally high capture rates encountered in São Tomé and the low capture rates in Príncipe indicates a much higher density of birds at low levels in the primary forests of São Tomé than on Príncipe, although as higher storey species were not adequately sampled by our study, comparison of overall bird abundance in the forests of the two islands is impossible. In addition, the relative influences of chance factors both in general (habitat) and the specific (choice of localities) are also unknown.

The data regarding moult, and the relative influence of chance factors both in general (habitat) and the specific (choice of localities) is also unknown. timing provide an indication of the timing of breeding, as it is generally true that breeding is immediately followed by moult<sup>5</sup>. Therefore, it appears that for most species mist-netted on São Tomé during the study, breeding was complete by late December–January, with a high proportion moulting by early February. Further moult studies throughout the remainder of the year should provide a more complete appreciation of the biology of São Tomé's birds, and future researchers trapping birds there are recommended to collect moult information for this purpose.

The importance of lowland primary forest on São Tomé for endangered endemic species is highlighted by our study, with two species considered globally threatened by BirdLife International<sup>1</sup>, São Tomé Short-tail *Amaurocichla bocagei* and São Tomé Fiscal *Lanius newtoni*, being trapped only in this habitat. Much of the lowland primary forest of São Tomé and Príncipe has already been lost, and the remaining areas are

threatened by near-future development projects. It is well known that these areas support a rich endemic fauna and flora, and yet almost ten years after the publication of recommendations regarding the threatened biodiversity of the Gulf of Guinea islands<sup>8</sup>, the lowland primary forests of São Tomé and Príncipe remain unprotected. It is hoped that a recent resurgence in international interest in the biodiversity of these islands may stimulate renewed efforts to ensure the long-term conservation of these exceptional forests and their unique biodiversity.

**Acknowledgements**

We thank Rachel Atkinson, Pedro Leitão, the staff of ECOFAC São Tomé and Príncipe, Angus Gascoigne and Peter Jones. The Davis Expedition Fund, the British Ecological Society and the John Ray Trust funded our work, with additional support from Garmin (Europe) Ltd and Berghaus Ltd. ☺

**References**

1. BirdLife International 2000. *Threatened Birds of the World*. Cambridge, UK: BirdLife International & Barcelona: Lynx Edicions.
2. Borrow, N. and Demey, R. 2001. *Birds of Western Africa*. London, UK: Christopher Helm.
3. Cheke, R.A. and Mann, C.F. 2001. *Sunbirds: A Guide to the Sunbirds, Flowerpeckers, Spiderhunters and Sugarbirds of the World*. London, UK: Christopher Helm.
4. Christy, P. and Clarke, W.V. 1998. *Guide des Oiseaux de São Tomé et Príncipe*. São Tomé: ECOFAC.
5. Dowsett-Lemaire, F. and Dowsett, R.J. 1991. The avifauna of the Kouilou basin in Congo. *Tauraco Res. Rep.* 4: 189–239.
6. Fry, C.H., Keith, S. and Urban, E.K. (eds) 1988. *The Birds of Africa*. Vol 3. London, UK: Academic Press.

7. IUCN. 2002. *IUCN Red List of Threatened Species*. Gland: IUCN.
8. Jones, P.J. 1994. Biodiversity in the Gulf of Guinea: an overview. *Biodiv. & Conserv.* 3: 772–784.
9. Juste, J.B. and Fa, J.E. 1994. Biodiversity in the Gulf of Guinea islands: taking stock and preparing action. *Biodiv. & Conserv.* 3: 759–771.
10. Peet, N.B. and Atkinson, P.W. 1994. The biodiversity and conservation of the birds of São Tomé and Príncipe. *Biodiv. & Conserv.* 3: 851–867.
11. Svensson, L. 1992. *Identification Guide to European Passerines*. Stockholm: privately published.

<sup>a</sup>Projet Protection des Gorilles, BP 13977, Brazzaville, Republic of Congo. E-mail: ppg@uuplus.com.  
<sup>b</sup>Department of Ecology and Evolutionary Biology, 310 Dinwiddie Hall, Tulane University, New Orleans, LA 70118, USA. E-mail: martindallimer@yahoo.com.

# Safari Wise



... a head above the rest

Tailor-made tours to Southern Africa

Please visit our websites  
for 2004 departure dates.

Contact us for free quotations.  
SOUTH AFRICA  
NAMIBIA  
BOTSWANA  
MOZAMBIQUE

Affordable...experienced...qualified...licensed  
... good value!  
www.birdwatching.com.na  
www.birdwatching.co.za